

# Visualization of the Biliary Tract

## Preoperative, Operative and Postoperative Radiologic Investigation

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DISEASE OF THE extrahepatic biliary tract is so common and its diagnosis so important that every physician should recognize the various clinical forms of the disease and appreciate the place of radiologic visualization in its management. Although not every patient with extrahepatic biliary disease is a candidate for operation, it has been customary to consider radiologic investigation under the categories of preoperative, operative and postoperative roentgenography.

The traditional management of a patient with cholecystitis and cholelithiasis would start with preoperative investigation by oral cholecystography. During the operation itself, operative cholangiography might be used and in the postoperative period visualization of the extrahepatic biliary tract could be accomplished by cholangiography before removal of a T-tube in the common duct. Recently these divisions of radiologic investigation according to their relation to operation have been rendered less clear cut by the use of intravenous cholangiography for preoperative and postoperative biliary tract visualization and the use of newer oral cholecystographic methods in competition with intravenous cholangiography for postoperative investigation. The use of percutaneous puncture of the liver or gallbladder (a form of operative cholangiography) for preoperative visualization of the extrahepatic biliary system is mentioned only to condemn it.

It is the purpose of this presentation to discuss the various methods for roentgen visualization of the extrahepatic biliary tree with certain clinical observations on the advantages and disadvantages of each technique.

### Oral Cholecystography

This 35-year-old technique was originally employed to demonstrate the presence of pathologic change in the gallbladder, especially calculous cholecystitis. Although Graham and Cole in their original comments on the method suggested the probability of improved agents, these were slow in being devel-

• Modern operative treatment of diseases of the bile passages requires the use of x-ray visualization of the biliary tract before, after and during operation. Nearly every surgeon uses x-ray study of the biliary tract before operation and it is widespread practice to carry out such study after operations in which a tube has been placed in the bile passages. However, there is a remarkable aversion to operative cholangiography.

The usual reasons for avoiding operative cholangiography are unfamiliarity, inertia, concern over complications of the technique, and the feeling that it is unnecessary or wasteful of surgeon's time and patient's money. Yet the results of operative cholangiograms compare favorably with those obtained with the more customary x-ray studies of the bile ducts carried out after operation, at a time when the information gained is much less valuable in avoiding additional operations and in contributing to a smooth and rapid convalescence.

oped and for many years the original tetraiodophenolphthalein (Iodeikon®) was employed despite a relatively high incidence of adverse gastrointestinal reactions. This agent was gradually supplanted by iodoalphonic acid (Priodax®) which was much better tolerated but is inferior to more modern agents such as iodophenoic acid (Teridax®) and iodopanoic acid (Telepaque®). As with all iodine-containing compounds, certain side reactions may occur even with these newer agents, but such reactions are uncommon and are rarely dangerous.

With the standard dose of iodopanoic acid, it is quite common to visualize the extrahepatic biliary ducts together with the gallbladder. Even if the gallbladder is not visualized, as in patients with obstruction of the cystic duct, the extrahepatic bile ducts may be shown some 12 hours after oral administration, particularly if a double dose of the agent is given.

This high-contrast property of the newer agents may be helpful in distinguishing between liver disease and gallbladder disease. In liver disease, failure to visualize the extrahepatic biliary tracts may be occasioned by failure of excretion. In gallbladder disease, however, the radiopaque material is prevented from entering the gallbladder even though it is excreted in adequate concentration by the liver.

Guest Speaker's Address presented before the Section on General Surgery at the 88th Annual Meeting of the California Medical Association, February 22 to 25, 1959, San Francisco.

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In one series of 67 patients with nonvisualizing gallbladder, the common bile duct was seen radiologically in over 70 per cent.

For years it has been customary in the use of oral cholecystography to withhold fat in the diet on the day preceding the examination. In patients who for a long time have been on a rigid fat-free diet, the gallbladder occasionally fails to concentrate the radiopaque agent because it is already filled with inspissated bile at the time it is ingested. It was observed that in certain patients whose gallbladder had been stimulated to empty by the customary fatty meal after the initial roentgenogram, the gallbladder would be visualized as an accidental finding during other abdominal roentgenograms 12 to 24 hours later. Thus there is considerable logic in the practice of requesting patients to take some fat-containing food on the day preceding the oral cholecystography in order to empty the gallbladder and have it fill with bile containing the ingested radiopaque agent.

The older agents for oral cholecystography not infrequently failed to delineate the gallbladder even when there was no pathological change in that organ. This led to the practice of repeating an unsuccessful test, using a double dose of the agent. This practice is occasionally employed even with the newer agents such as iodopanoic acid. Within the past two years, a further extension of this trend has led to administration of 1 gm. of iodopanoic acid after each meal for as long as four to seven days, with the patient maintained during this period on a fat-free diet. Paregoric is given frequently to control occasionally troublesome diarrhea. In such circumstances, the visualization of radiolucent stones may be achieved not only in the gallbladder, but in the common bile duct as well. In vitro and in vivo studies have shown that certain biliary calculi may concentrate the cholecystographic medium in layers of biliverdin at the periphery of the stone, giving a ring-like appearance which stands out prominently. More commonly, in our experience, the stones are demonstrated by negative shadows in the duct. This may occur even in the presence of jaundice.

Further laboratory studies and wider clinical application of this technique of repeated dosage of the oral cholecystographic agents will permit more precise final evaluation. It is possible at this time to say that the method offers considerable promise in the appraisal of that troublesome group of patients with persistent symptoms after cholecystectomy. In some instances, the technique is more effective than intravenous cholangiography in demonstrating retained common duct stones after operation.

While it is not the purpose of this presentation to discuss fine points of radiologic technique, it

should be stressed that one must always be sure that the tablets have been ingested and that there has not been vomiting or diarrhea. In the absence of severe depression of hepatic function, failure to visualize the gallbladder with iodopanoic acid indicates disease of the gallbladder. Although the degree of gallbladder disease cannot be predicted from the density of the shadow, a faintly visualized gallbladder suggests strongly the presence of cholecystitis. It is worth remembering that the use of iodopanoic acid by the standard technique may give shadows of such density that radiopaque stones can be missed unless adequate scout films are taken.

#### **Intravenous Cholangiography**

Although the widespread use of intravenous agents for contrast visualization of the biliary tree did not begin until 1953, it should be remembered that early in the history of cholecystography the one available agent, tetraiodophenolphthalein, was not infrequently given intravenously when oral administration was ineffectual or poorly tolerated. In 1953, sodium iodipamide (Cholografin®, Biligrafin®) was introduced by various European investigators. Even with careful slow injection, the incidence of adverse reactions varies from 10 to 20 per cent. These generally consist of gastrointestinal symptoms such as nausea and vomiting or allergic manifestations such as urticaria, itching, and occasionally bronchospasm. Serious reactions, however, are rare.

The main utility of intravenous cholangiography lies in investigation of patients with persistent symptoms after cholecystectomy. In most of these patients, the common duct can be demonstrated fairly clearly although in half of such patients, the important lower end of the duct is not demonstrated, which limits sharply the value of the method. Moreover, with severe impairment of hepatic function or with serum bilirubin above 5 mg. per 100 cc. the likelihood of visualization of the common duct is small.

The density of the shadow with serial films may be used as an indicator of obstruction in the common bile duct. If the density of the shadow after intravenous cholangiography is greater at two hours than at any preceding time, this may indicate significant blockage of the common duct. The nature of this obstruction remains nonspecific until exploration distinguishes between calculi in the duct and obstruction at the sphincter due to fibrosis or neoplasm.

Although intravenous cholangiography may give valuable information after failure of biliary visualization by the usual oral cholecystographic techniques, it is not to be considered as a substitute for oral cholecystography. The incidence of unpleasant

side reactions is definitely higher with the intravenous than with the oral technique and, as previously noted, the newer oral methods may demonstrate otherwise invisible radiolucent calculi that are missed even with intravenous cholangiography.

It is essential to introduce a word of caution against relying too heavily on radiography alone in diagnosis of biliary disease. Frequently the clinical symptoms are clearly diagnostic of gallbladder disease and additional laboratory studies serve only to harass the patient and increase his expenses. Moreover, such studies may dangerously delay an operation which is urgently needed.

A case in point is that of a young woman recently seen with the classical symptoms of empyema of the gallbladder. She was treated nonoperatively with antibiotics for a long period when cholecystostomy would have relieved the symptoms and doubtless favorably affected the septicemia resulting from empyema. Thereafter she was submitted to oral cholecystography with single and double dosage and intravenous cholangiography. None gave visualization of the biliary system. Finally, some two months after studies were begun, a successful demonstration of nonopaque stones in the gallbladder was achieved by administration of iodopanoic acid for four days. Three days after this diagnostic triumph, there was violent exacerbation of the inflammatory process in the gallbladder, which was palpable, and the patient was transferred to the surgical service for emergency cholecystostomy. It seems unnecessary to labor the moral of this story, which exemplifies the overemphasis of diagnosis to the exclusion of the patient's best interests.

#### **Operative Cholangiography**

Operative cholangiography is generally discussed in surgical journals, but there is merit in outlining its usefulness and indications before a wider medical audience. Although operative cholangiography has been in use for at least 20 years, many surgeons are still reluctant to employ it. Failure to use the method is based on a variety of objections which may be valid in some instances but are generally an indication of inertia. It is remarkable that many surgeons who avoid the use of cholangiography during operation will employ it to demonstrate the bile ducts several days or weeks after operation at a time when correction of abnormalities will ordinarily require a second laparotomy. In contrast to this, the demonstration of abnormalities at the time of initial laparotomy permits correction of them with minimal morbidity and lessens the expense and trouble of prolonged stay in hospital.

It has been said that the use of operative cholangiography is unnecessary if one is skilled in operative exploration of the common bile duct. While the

degree of skill obviously varies from surgeon to surgeon, there is no one so skilled that he does not occasionally fail to find a stone which subsequently manifests its presence in the common duct. Even the most skillful probing and irrigation may fail to detect or bring into view stones that are present in the intrahepatic radicles of the biliary ductal system.

Operative cholangiography has been said to be dangerous because it gives assurance which is not justified by the results obtained. The answer to this objection lies in the fact that operative cholangiography is not a substitute for common duct exploration, but is rather a supplementary technique of examination which may be carried out after the most meticulous exploration, which will sometimes fail to reveal stones. Exploration of the common duct by manipulative methods and roentgenographic methods are complementary, not each exclusive of the other.

Operative cholangiography has been attacked because it is troublesome to do and because there are both false negative and false positive cholangiograms in a certain proportion of cases. The trouble and expense of operative cholangiography have been somewhat overrated and the additional expense is trivial when compared with the catastrophic hospital bills incident to surgical treatment of retained common duct stones. It is apparent that technical difficulties are always a possibility, but these may be solved if one has in view the desirable goal of avoiding even one retained common duct stone. For best results, the cooperation of the radiologist is obviously essential; however, operative cholangiography even under technical and consultative difficulties is more helpful than no cholangiography at all.

The most significant and cogent reason for using operative cholangiography lies in the demonstration on our own material that 8 per cent of the patients who were judged by all other available methods to have extrahepatic biliary ducts free of stones, were found by operative cholangiography to have stones in the biliary ducts. In these patients, the responsible surgeon had exerted diligent efforts to detect stones by all practical means short of operative cholangiography. Except for operative cholangiography, stones would have been left behind. This would not necessarily have occasioned symptoms since patients with stones in the common duct may be fortunate enough to pass them with negligible clinical disturbance. Moreover, it is possible that a nonoperative regimen designed to cause passage of common duct stones may be successful. One can scarcely escape the conclusion that in a significant number of patients the use of operative cholangiography gives information which is not available in any other way and that this information is beneficial to the surgeon and to the patient.

One form of operative cholangiography mentioned earlier is the blind percutaneous injection of radiopaque materials into the gallbladder or intrahepatic bile ducts. It is our belief that this is a dangerous and unwarranted practice. We treated surgically four patients with biliary peritonitis or intraperitoneal hemorrhage that resulted from such tests. These four complications occurred in a group of 15 patients so tested, and in no instance among the four patients was the diagnosis materially aided by the study. Certain South American observers have reported the use of pneumoperitoneum to delineate the gallbladder so that it may be punctured more readily, but this too seems to be an instance of diagnostic ingenuity exceeding common sense and regard for the patient's safety. In an occasional case of jaundice where radiographic visualization of the ducts is essential and cannot be achieved short of direct injection, this may be safely done by exposure of the gallbladder through a short lapa-

rotomy incision under local anesthesia. This is a major diagnostic effort but it has the advantage of direct closure of the puncture wound in the gallbladder and the comfortable realization that the added surgical manipulation has been justified by the diminished risk of biliary peritonitis. In this sense, it is comparable to the conventional postoperative cholangiography through an inlying tube placed in the gallbladder at a formal cholecystostomy.

We have had no personal experience with air contrast cholangiography suggested recently by Bertino and Cole.<sup>1</sup> Their preliminary report based on use in 17 patients indicated only that it was feasible, safe and useful.

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#### REFERENCE

1. Bertino, G. G., and Cole, J. W.: Air contrast cholangiography, a preliminary report, Surg., 43:795, 1958.

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